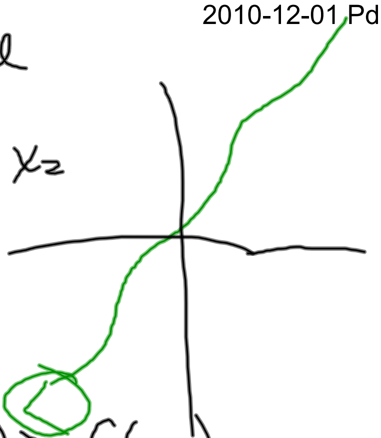
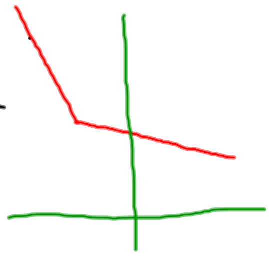
$f(x)$ is decreasing (increasing) on an interval $[a,b]$ if for every x_1 and x_2 in $[a,b]$ then

$$x_1 < x_2 \Rightarrow f(x_1) > f(x_2)$$



If $f'(x)<0$ on $[a,b]$ then $f(x)$ is decreasing on that interval

If $f'(x)>0$ for all x in $[a,b]$ then $f(x)$ is increasing on that interval



I am thinking of a function where $f'(1)=2$. Can you tell me anything about increasing/decreasing?

A function $f(x)$ is concave up on an interval $[a,b]$ if $f'(x)$ is increasing on (a,b).

Thm: If $f''(x) > 0$ on an interval (a,b) then $f(x)$ is concave up on that interval

Concave down is when $f'(x)$ decreasing.

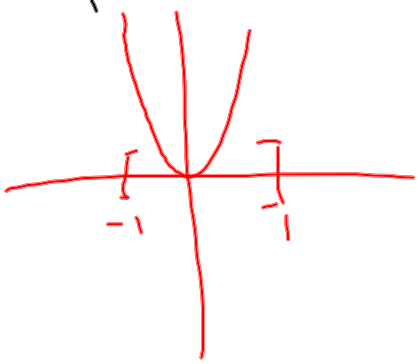
if $f''(x) < 0$ then f is concave down.

Can you construct a fn. that is concave up, but for which $f''(x)$ is not positive everywhere?

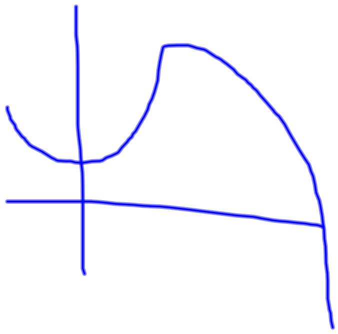
$f(x) = x^4$

$f'(x) = 4x^3$

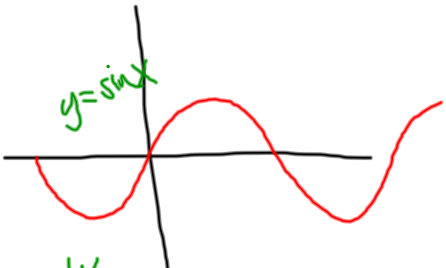
$f''(x) = 12x^2$



A pt of inflection:
is a pt on a curve where the concavity of the curve chgs from c-up® Kevin Abrahams to c-dn
OR c-dn to c-up.

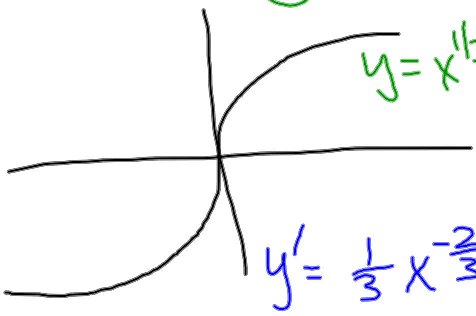


Thm A pt of inflection requires $f''(a)=0$ OR $f''(a)$ does not exist



$y' = \cos x$

$y'' = -\sin x$



$y' = \frac{1}{3}x^{-\frac{2}{3}} = \frac{1}{3x^{2/3}}$

$y'=0$ nowhere
y' is undefined at $x=0$

y': + und + (at 0)

$y'' = -\frac{2}{9}x^{-5/3} = \frac{-2}{9x^{5/3}}$

$y''=0$ nowhere
y'' not def $x=0$ . . .

y'': + — (at 0)

5.1 examples

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$f(x)$ is ~~increasing~~ decreasing on an interval $[a,b]$

if, for every x_1 and x_2 in $[a,b]$

we have

$$x_1 < x_2 \Rightarrow f(x_1) < f(x_2) \quad (>)$$

"Increasing"

decreasing

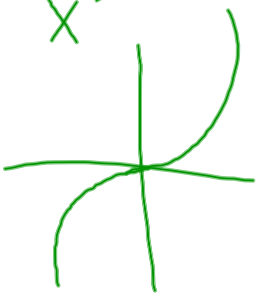
Shut up Fred

Thm: If $f'(x) > 0$ ($<$) on (a,b) then $f(x)$ is increasing (decreasing) on $[a,b]$

This does NOT say if a function is increasing then $f'>0$.

CAN you find an example of a function that is increasing o.a.i. but doesn't satisfy $f'(x)>0$

x^3



5.1 examples

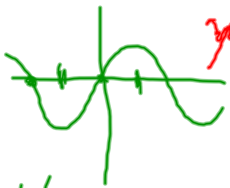
A function $f(x)$ is concave up (dn) on an interval if $f'(x)$ is increasing (decreasing) on that interval.

Thm: if $f''(x) > 0$ (<0) then

$f'(x)$ is increasing (decreasing) and . . .

f is concave up (dn).

$y = \sin x$

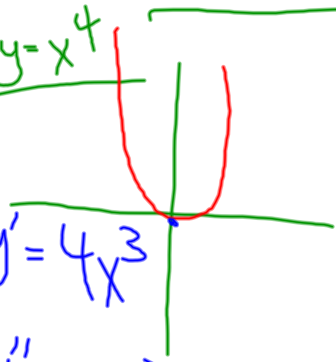


$y' = \cos x$

$y'' = -\sin x$

Think of a function that is c-up but for which $f''(x)$ is not always +.

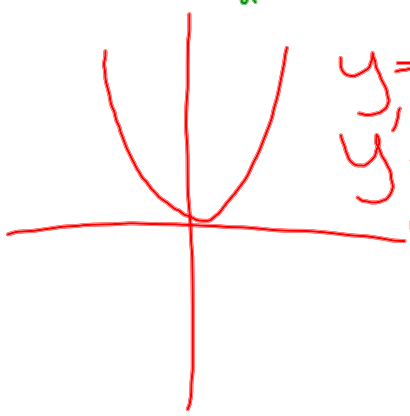
$y = x^4$



$y' = 4x^3$

$y'' = 12x^2$

$f''(x)$ is not +
- neg.
- 0
- und



$y = x^2$

$y' = 2x$

$y'' = 2$

A pt of inflection is a pt on the curve of $f(x)$ where the f^{n} chgs from

C-up to c-dn

$f^{(n)}$ nth deriv

OR C-dn to c-up. vice-versa

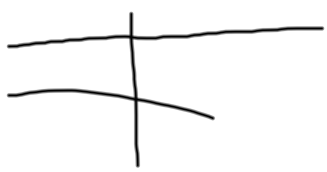
A pt of inflection must have either

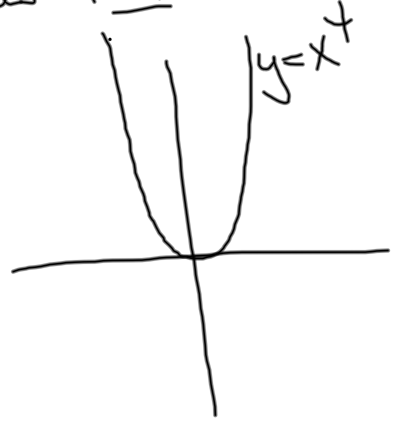
$-f''(a)=0$

$f(x)=c$

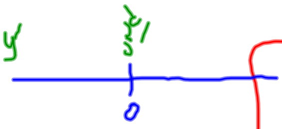
$f''(x)=0$

OR $-f''(a)$ does not exist



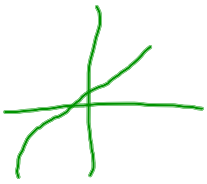


for $y = x^{1/3}$ $\quad y' = \frac{1}{3}x^{-2/3} = \frac{1}{3x^{2/3}}$



$y' = 0$ where?
nowhere
y' undefined?
$x = 0$

- what intervals ~~does~~ is y increasing
- " " " " decreasing
- " " " " c-UP
- " " " " c-dn
- any pts of inflection?



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